Claims

1. An arbitration method for use in selecting the connections to be made between ingress and egress ports of a memoryless cross-bar switch of a data switching system, the arbitration method comprising a three phase process involving (i) a request phase in which each ingress port sends its connection requests to the egress ports to which a connection is required, (ii) a grant phase in which each egress port examines in a round-robin manner the requests directed to it using a grant pointer, and selects one request for grant returning a grant signal indicative of the selected request and directed to the ingress port which sent the selected request, and (iii) an accept phase in which each ingress port examines in a round-robin manner the received grant signals and selects one to accept thereby defining an ingress to egress port connection across the cross-bar switch, characterised in that the transition sequences for each of the grant pointers are mutually exclusive.

2. A method according to claim 1 in which the mutually exclusive transitions are determined by a connection matrix setting the pathways of request and grant signals.

3. A method according to claim 2 wherein said connection matrix may be represented by a table having columns representing respective egress ports, the entries in the table along any column represent, in vertically descending order, the ingress ports to which the grant pointer of the corresponding egress port points, and the table does not contain, in the same vertically descending order, multiple instances of any combination of a first ingress port and a second ingress port.

4. A method according to claim 2 wherein the entries in the table conform to the formula:

$$M^* = \left(P + \frac{M(M+1)}{2} \right) \bmod N \qquad (1)$$

where N is the number of egress ports, M is an integer index in the range 0,...,(N-1) which labels the rows of the matrix, P is an integer index in the range 0,..., (N-1) which labels the N columns of the matrix, and M* is the entry in the table at row M and column P.

5. A method according to claim 1 which employs, for each possible combination of an ingress port and an egress port, a respective weight value, a connection request only being selected in said grant step if the corresponding weight value is not zero;

the method further comprising:

each time a connection is made in the crossbar switch involving an ingress port and an egress port, decrementing the corresponding weight value; and

in said grant phase, if for a given egress port, there are no connection requests having non-zero weight values, the weight values are reset to default values before said selection.

6. A method according to claim 5 including a further step of setting said default values according to a desired statistical frequency of connections between specific ingress and egress ports.

7. An arbitration unit for use a data switching system comprising a plurality of ingress ports, a plurality of egress ports, a memory-less cross-bar switch and said arbitration unit for controlling the switch, the arbitration unit comprising:

a respective first portion for each of said ingress ports, and a respective second portion for each of said egress ports,

each first portion being arranged to transmit connection request signals relating to required connections between the corresponding ingress port and the egress ports, to the second portions corresponding to those egress ports;

each second portion being arranged to define a grant pointer having a transition sequence, to examine in a round-robin manner using the corresponding grant pointer the request signals directed to it, to select one request signal for grant, and to return to the first portion which transmitted that request signal a grant signal indicative of the selected request;

each first portion further being arranged to examine in a round-robin manner the received grant signals and select one to accept, thereby defining an ingress to egress port connection across the cross-bar switch,

characterised in that the transition sequences for each of the grant pointers are mutually exclusive.

8. An arbitration unit according to claim 7 further including a connection matrix determining the mutually exclusive transitions by defining the pathways of the request and grant signals.

9. An arbitration unit according to claim 8 wherein said connection matrix can be represented by a table having columns representing respective egress ports, the entries in the matrix along any column represent, in vertically descending order, the ingress ports to which the grant pointer of the corresponding egress port points, and the matrix does not contain, in the same vertically descending order, multiple instances of any combination of a first ingress port and a second ingress port.

10. An arbitration unit according to claim 8 wherein the entries in the table conform to the formula:

$$M^* = \left(P + \frac{M(M+1)}{2} \right) \bmod N \qquad (1)$$

where N is the number of egress ports, M is an integer index in the range 0,...,(N-1) which labels the rows of the table, P is an integer index in the range 0,..., (N-1) which labels the N columns of the table, and M* is the entry in the table at row M and column P.

11. An arbitration unit according to claim 7 which further includes, for each possible combination of an ingress port and an egress port, a working register storing a respective weight value,

the working register decrements each weight value each time a connection is made in the crossbar switch involving the corresponding ingress port and egress port, and, if there are no connection requests to a given egress port having non-zero weight values, resets the weight values for the egress port to respective default values before said selection step; and

each second portion only selects a connection request if the corresponding weight value is not zero.

12. A data switching system comprising a plurality of ingress ports, a plurality of egress ports, a memory-less cross-bar switch and an arbitration unit according to claim 7 arranged to control the switch